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Changes in artefact assemblages during the last 8 000 years at Walyunga, Western Australia

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Abstract

Excavations at Walyunga, a large open site near Perth, Western Australia, produced an artefact sequence and datable charcoal, indicating recurrent occupation of the site through most of the Holocene period. Marked changes between assemblages from lower and upper levels occurred about 4 600 years ago. "Backed blade" and "flat adze" tools were found only in the upper levels. The presence of bryozoan chert artefacts in the lower levels only, supports a recent hypothesis by Glover (1975), that the chert sources lay exposed off the west coast until submerged by rising sea levels. The sequence and dates now indicate that sources are close to the present sea level.

Introduction

The excavations at Walyunga were designed to produce "backed" tools from stratified assemblages in a datable deposit. Tools of this type (backed blades and geometric microliths) were recovered from dated contexts in three earlier excavations in Western Australia, at Puntutjarpa in the Western Desert (Gould 1968), at Frieze Cave 90 km east of Perth (Hallam 1972) and at Northcliffe near the south coast (Dortch 1975). Such tools occurred in small quantities in surface samples from about 20% of artefact sites recorded near Perth by Hallam (1972).

Walyunga was selected for detailed investigation since it is one of the few large sites near Perth having numerous artefacts, including backed tools, exposed over a wide area (Butler 1958, Akerman 1969, Turner 1969). The site lies within Walyunga National Park near the west bank of the Swan River valley in the Darling Range about 38 km northeast of Perth. Artefacts occur over an area about 200 x 200 m on the eroding surface of a sand dune resting on the lower slopes of a granite hill. On the western side of the dune an old fence is partly covered by sand. Since the fence is European the sand must have accumulated there to a depth of more than a metre in less than 150 years. Contours of the dune (Fig. 1) indicated movement of sand from east to west, and it seemed possible that a similar but slower movement may have occurred in the prehistoric period. This was supported by excavations which revealed a deep stratified deposit containing charcoal and numerous artefacts. Backed tools were confined to the upper levels, and several other changes occurred through the sequence.

Excavations

With student assistance I excavated two trenches (C18 and B6), each 1 m², near the crest of the dune (Fig. 1). The trenches were 25 m apart and contained similar artefact sequences. Trench B6 reached 140 cm below surface yielding 690 artefacts spread through all levels.

The main trench (C18) was excavated in spits of 5 cm depth or less, to a level 190 cm below surface, yielding artefacts in every spit except the last two (180-190 cm). Two holes drilled below 190 cm reached hard base (probably granite) at 5.1 m below surface. Sand from the bores contained no artefacts nor charcoal. The trench yielded 2 874 flaked artefacts, 302 non-flaked items and 1 071 g laterltic gravel (Table 1).

Within several spits artefacts were concentrated in narrow bands about 2 cm thick, possibly indicating conditions of temporary stand-still or erosion. These were not accompanied by distinctive soil changes except near 16 cm, where the upper loose orange sand changed abruptly to dark brown firm soil. This may be the buried humic zone of an old soil covered by sand wind blown from deflating areas of the dune. Numerous stone artefacts and iron fragments lay at the interface, indicating that the dune crest was once subjected to erosion, like other parts of the site at present. This erosion, and the rapid sand build-up at the fence, may be related to disturbance of local environment by European activities.

Artefacts occurred above 16 cm, either as a result of European activities or of Aboriginal usage of the site after European occupation.

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Table 1

Analysis of excavated material from trench C18, Walyunga

Depth (cm)	Spit No.	Primary flake: Chip 0–1 cm	Primary flake: Chip 1–1½ cm	Primary flake: Flake	Primary flake: Blade	Primary flake: Flaked piece	Secondarily worked: Utilized non-formal	Secondarily worked: Trimming flake	Secondarily worked: Steep scraper	Secondarily worked: Scraper	Secondarily worked: Adze misc.	Secondarily worked: Adze flat	Secondarily worked: Backed tool	Secondarily worked: Fabricator	Secondarily worked: Other formal tools	Total flaked artefacts	Non-flaked: Fragment & nodule	Non-flaked: Lump	Non-flaked: Abraded lump	Non-flaked: Ochre granule	Non-flaked: Hammer	Non-flaked: Pebble	Non-flaked: Iron and glass	Non-flaked: Lateritic gravel (grams)	Distribution of some types of material: Bryozoan chert	Distribution of some types of material: Silcrete	Distribution of some types of material: Mylonite	Radiocarbon dates bp (Libby years)
0– 8	1	3	3	6		1	3	1						1		18	1		2	1			4				4	
8– 15	2	32	17	8		2	13	3	1	4	2	1		4		87	1						2	10			11	
15– 20	3	407	103	35	2	3	25	2		9	2	3	1	9	2	602	8	1		11			26	215	1		22	
20– 25	4	161	47	26		1	5	2	1	4	1		1	2	1	253	3	1		7			3	30			21	**1 330 + 100 bp SUA 632
25– 27	5	7	6	5		1	2			2		1				24	1		..	1				5			7	
27– 30	6	39	15	6		1	2						1			64	2			3				19			5	
30– 35	7	20	9	6	1	..		1		2	1		..			40	3			3				14			3	
35– 37	8	31	8	3		1			1	1	..	1	1			47	2	1		3	1			17			3	
37– 40	9	20	4	5		1	1	1				4				36	1			3		1		34			8	
40– 45	10	11	6	3						1	1	..	1			23				6				8			3	
45– 50	11	28	6	4			1		1				1			41	1			3				22			8	
50– 55	12	23	1			1	1				1					27				4				21			4	
55– 60	13	45	1	2	.	..	1									49				2				25			5	
60– 65	14	25	5	3			4						2			39			1	2				19			6	**3 220 + 100 bp SUA 508
65– 70	15	31		4	1			1						....		37	1			1				22			2	
70– 75	16	42	1	7			1			1	1	1				54	2		1	18				31			3	
75– 80	17	18	10	13	.	1	2			1						45	1			10				24	3	1		**4 560 + 150 bp SUA 633
80– 85	18	30	11	3			4		3	1				1		53	1			9				35	1			
85– 90	19	29	7	4			4	1		1				1		47	4			7				27	4	2		**6 135 + 160 bp SUA 509
90– 95	20	35	11	9		1	9		1	2				1		69	1			5				52		1	4	
95–100	21	45	7	6		1	4								1	64	3	2		3		1		42	4		2	
100–105	22	34	7	3		1	4	1		1				...		51	2			1				40	1		5	
105–110	23	34	6	5		1	2		2	2						52		1	1	6				31	2	1		
110–115	24	27	6	5	1		2	1	1	1						44	3			2				35			1	
115–120	25	35	9	6			3	1		1						55	2			8				29	2	1		
120–125	26	36	6	6			3	1		1						53	2			5				21	3		1	
125–130	27	86	10	13		3	9	1								122	2							45	4	4		
130–135	28	77	9	4		1	3	1						1		96	5	1		12				32	2	2	1	
135–140	29	64	10	8			8			1						91	1			11				26	4	1	2	
140–145	30	56	11	13		1	4	1		1						87	2			4				18	3	1	2	
145–150	31	79	14	2		4	5	2	1	2					1	110	5			3				20	4		2	
150–155	32	69	7	6	1	2	5			1					1	92	3	2						12	2	2		**8 000 + 260 bp SUA 510
155–160	33	60	18	7		1	4	1				..	....	1		92	1		...	6				20	1	3	3	
160–165	34	73	9	8		4	2			1						97		1	1	2		3		17		3		
165–170	35	62	7	9		2	4					..		....	..	84	1			14	....	1		13	3	3	1	
170–175	36	15		1		..	3			....	....	...		.		19				3				16	1		..	
175–180	37	10	..	..												10								19				
180–185	38	0	...											...		0				..		..	.	4				
185–190	39	0														0						....		1				
Totals		1 899	407	254	6	35	143	22	12	41	9	11	8	21	6	2 874	65	10	6	179	1	6	35	1 071	45	25	139	

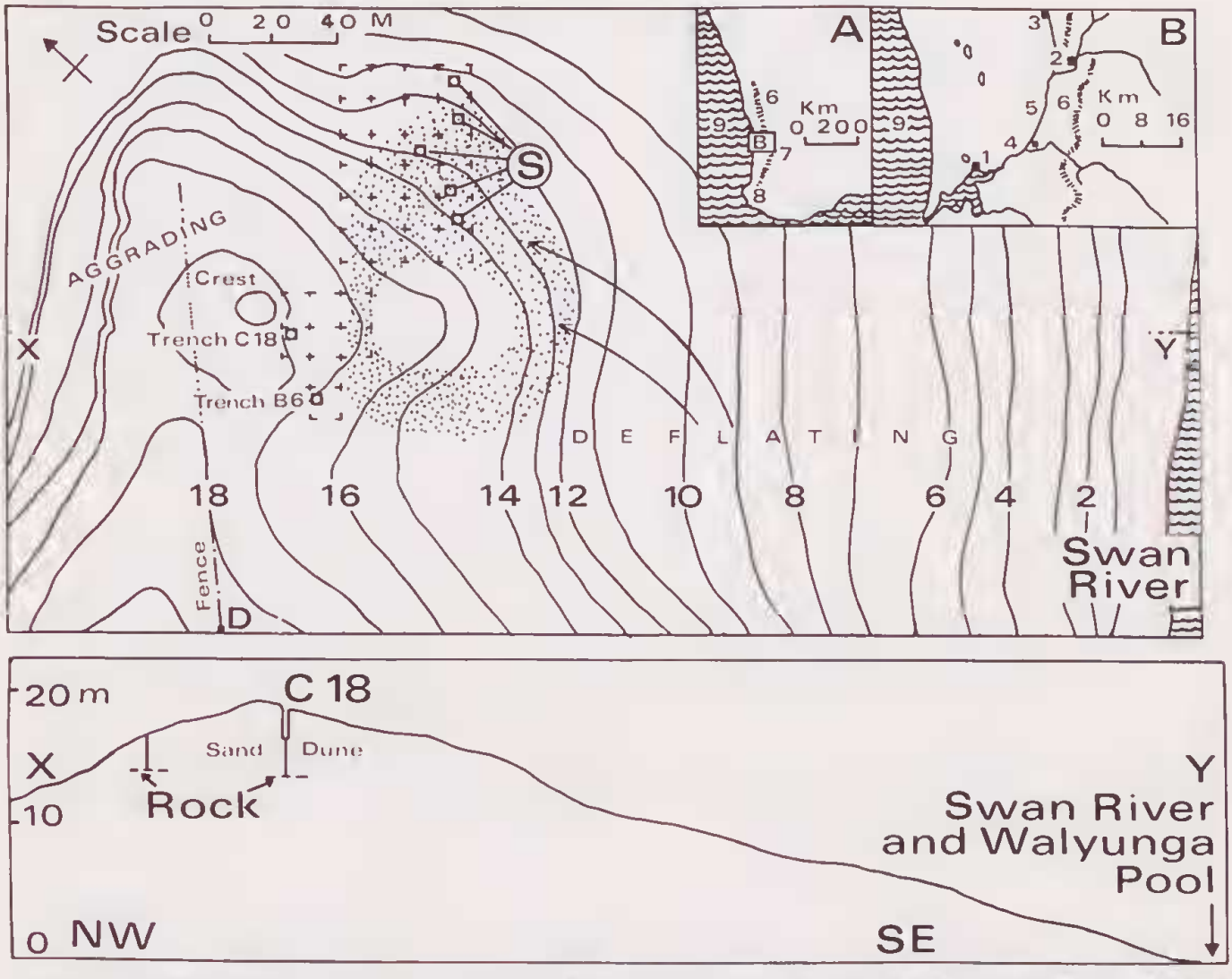

Figure 1.—Contour map and profile of Walyunga site, Walyunga National Park, Western Australia. Map reference SH50-14 4064 0743. Contour lines at 1m intervals above river level. Stippling indicates the area of high surface density of artefacts. Crosses indicate the area set out with 10x10 m squares for sampling. S — Positions of surface samples. C18 — Main excavated trench. B6 — Second excavated trench. D — Site datum. Dune profile; vertical scale = 5x horizontal scale. Inset A — South West of Western Australia. Inset B — Perth — Walyunga district. Key to numerals on inset maps A and B: 1 Perth, 2 Walyunga, 3 Bullsbrook, 4 Guildford, 5 Swan River, 6 Darling Range, 7 Frieze Cave, 8 Devil's Lair, 9 Indian Ocean.

The latter is indicated by the presence of worked glass artefacts at other parts of the site (Akerman 1969). The material may represent a post-contact phase of the sequence.

Five samples of charcoal from trench C18 were analysed by R. Gillespie and R. B. Temple at Sydney University Radiocarbon Laboratory. I use their values based on the Libby half-life of 5 568 y, in this paper (Table 1, Fig. 2). These dates indicate occupation starting early in the Holocene and continuing at intervals until European settlement.

Petrology

The commonest material was quartz, used for more than 80% of artefacts in all levels. Small quantities of quartzite, dolerite, granite and ochre occurred through the deposit, more frequently in lower than upper levels. Lateritic gravel (total 1 071 g) was retained on the 3 mm screen, in quantities approximately proportional to the number of artefacts in each spit except for higher values in spits 16 and 18.

Bryozoan chert

Artefacts made of fossiliferous chert comprised about 3% of artefacts throughout the lower levels up to the level 75 to 80 cm below surface (spit 17, dated 4 560 ± 150 bp) (Fig. 2). Above 75 cm only one example occurred, within 16 cm of the surface, probably carried from an eroded part of the site.

Glover (1975) found artefacts of this chert, containing distinctive bryozoan fossils of Middle-Late Eocene age, at many prehistoric sites on the Swan Coastal Plain, yet none of the chert nor any rock of that age is known to outcrop at the present land surface in this area. Strata of that age are known from only one location

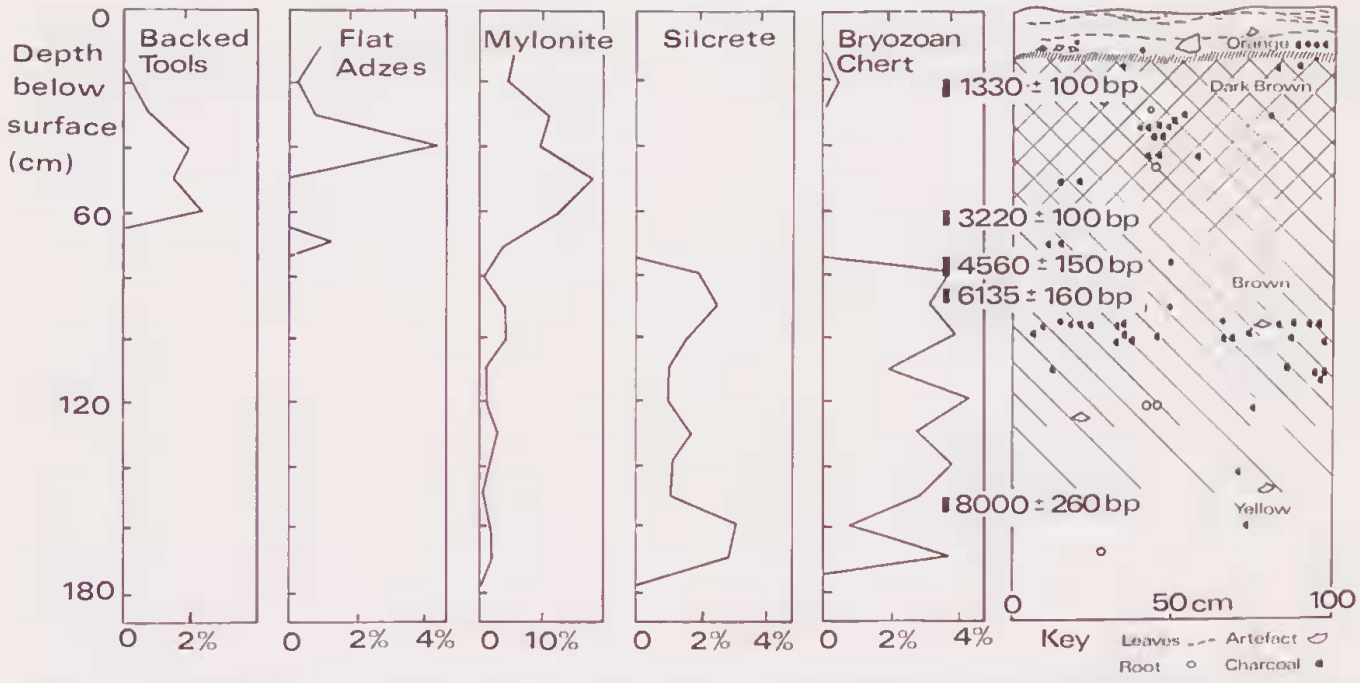

Figure 2. — Trench section, and changes of technology, trench C18 at Walyunga. The diagram shows the north-west wall in cross section with soil colour changes, the unconformity at 16 cm below surface, and positions of levels dated by charcoal samples listed in Table 1. Graphs show changes with time in percentages of some tool types and materials, calculated out of flaked items in each 10 cm interval.

in the Perth Basin, in an offshore well drilled about 60 km west of Mandurah (Glover 1975, p. 83). Glover pointed out " . . . that the sites with the highest proportion of these chert artefacts are invariably near the western coast" Chert artefacts of late Pleistocene age were excavated at Devil's Lair (Dortch and Merrilees 1973), and at Minim Cove near Perth (Clarke and Dortch 1977). Since sea level then was much lower than at present, Glover (1975, p. 84) proposed that the chert ". . . probably came from an off-shore source in the west . . . there is a probable pattern of west-east transportation . . . of fossiliferous cryptocrystalline chert from sites now submerged". If so then the source was cut off by rising sea level at some time before the present level was attained.

Thom and Chappell (1975) consider that the sea first reached its present level around the Australian coast about 6 000 years ago. Churchill (1959) suggested the date was around 5 000 years ago. The latest bryozoan chert in spit 17 of the Walyunga trench C18 may be contemporary with the charcoal sample (SUA 633) from that level, but it could have been deposited earlier if there was intervening erosion. This is not easily resolved since the change of depth with time is small at this level in the trench (Fig. 2). The evidence from this trench indicates that the chert continued to be available until about 4 560 ± 150 bp. In the second trench (B6) situated 25 m south of the main trench, charcoal from the level at 65-70 cm containing the latest bryozoan chert was dated 4 700 ± 215 bp (SUA 644). The combination of this with SUA 633 gives a satisfactorily tight bracket for cessation of chert use.

The presence of bryozoan chert artefacts through the lower levels of the Walyunga excavations, their sudden disappearance, and absence from the upper levels (with one exception mentioned above) support Glover's hypothesis that the source was cut off by rising sea level. The date indicated for disappearance of chert from the Walyunga sequence is close to but a little later than the date suggested at which the sea first reached its present level. The exact dates of these events and of changes in the local coastline are not yet known. The chert source may lie near present sea level, possibly quite close to the present coastline, or it may be buried under coastal deposits. The small quantities of this chert at Walyunga reflect the distance of the site—30 km—from the coast.

Silcrete

Silcrete artefacts occurred almost in parallel with bryozoan chert in the Walyunga sequence, indicating they might be closely related in usage. Possibly their sources were close together, submerged near the coast or under coastal deposits, or they may have been linked by trade or other cultural interaction that ceased when the chert disappeared. Silcrete artefacts occur in small quantities at some surface sites around Perth, but a source for the Perth and Walyunga material has not been established.

Mylonite

About 4% of artefacts in the Walyunga excavation were made of greenish "chert" containing thin veins of quartz. Glover (1976)

identified this material as mylonite and located outcrops on a granite hill adjacent to the Walyunga site.

Although a possible source is so close it occurred only sparsely in the lower levels of the excavation (1.7% of artefacts), but in significantly higher quantities (average 8%) in levels above 75 cm. A similar situation existed in the second trench. Possibly mylonite was a partial substitute after bryozoan chert and silcrete dropped out of the sequence, although these materials differ in petrology and to some extent in flaking properties (Glover 1975, 1976).

The change in usage of materials may be related to development of different tool types, depending on specific physical properties of the stone. Thus mylonite was used for 9 out of the 11 flat adzes and for only 3 other tools, all in the upper levels of the trench, where most of the 75 formal tools were made of quartz. Similar proportions exist in surface samples in which mylonite is 10% of all artefacts and 80% of flat adzes. This indicates preferential selection of mylonite for flat adze tools at this site.

Relationships involving trade between groups of people in the district (cf. Berndt and Berndt 1968, p. 111) may have been affected by the change in material usage, since in the early phase bryozoan chert was probably transported from west to east across the Swan Coastal Plain (Glover 1975, p. 84) while mylonite would have to be transported in the opposite direction to sites such as North Lake and Mongers Lake. Since the mylonite source was not covered by rising seas the material became more important in the second half of the Holocene, and may perhaps serve to indicate an age range of some assemblages.

Typology

Formal tool types—general.

Of the 2 874 flaked artefacts, 273 were secondarily worked or utilized, and of these 108 were recognizable formal tools. The proportions of formal tools were significantly higher in the upper than in the lower levels of the trench, 5.2% above 75 cm, as against 2.4% below 75 cm. The main differences between assemblages of upper and lower levels are summarised in Table 3. Artefacts were classified using current Australian typology (e.g. Mulvaney 1975).

Scrapers were fairly evenly distributed through the trench, indicating continuity of usage, but steep edge scrapers, all less than 4.3 cm long were less common in upper levels (larger items occur on the surface of the site).

Adze flakes occurred only above 75 cm. All are small non-tula forms (see "flat adzes" below).

Fabricators or "scalar cores" occur in significant numbers only near the top of the trench, but are present in small quantities in lower levels. This accords with early dates for fabricators from Green Gully (Wright 1970), Kow Swamp (Wright 1975), and Devil's Lair (Dortch

Table 2

A. Parameters of 'fabricators' excavated at Walyunga (N = 21)

	Mass (g)	Length (mm)	Width (mm)	Thickness (mm)	Length :width	Thickness :width
Mean	2·04	19·7	13·1	7·6	1·58	0·61
Standard deviation	1·06	4·89	3·69	1·75	0·53	0·18
Minimum	0·34	11·0	8·8	1·75	0·97	0·31
Maximum	4·72	28·4	19·2	11·0	2·93	0·90
Coefficient of variation	53%	25%	28%	23%	33%	30%

B. Parameters of flat adzes excavated at Walyunga (N = 11)

	Mass (g)	Length (mm)	Width (mm)	Thickness (mm)	Length :width	Thickness :width	Edge angle
Mean	0·86	18·4	9·9	4·3	2·2	0·47	56°
Standard deviation	0·58	3·4	3·1	0·94	1·1	0·16	13°
Minimum	0·32	13·3	4·4	2·7	1·2	0·3	31°
Maximum	2·21	23·5	16·0	5·9	4·8	0·9	86°
Coefficient of variation	67%	19%	32%	22%	50%	35%	20%

C. Parameters of 'backed' tools excavated at Walyunga (N = 13) (Includes 5 items from trench B6)

	Mass (g)	Length (mm)	Width (mm)	Thickness (mm)	Length :width	Thickness :width
Mean	0·337	13·2	7·6	2·9	1·76	0·38
Standard deviation	0·397	4·1	2·0	0·88	0·37	0·077
Minimum	0·05	7·9	4·0	1·5	1·23	0·27
Maximum	1·55	24·6	12·0	5·1	2·71	0·50
Coefficient of variation	116%	29%	26%	30%	21%	20%

Table 3

Summary of differences between assemblages of upper and lower levels. Percentages expressed out of all flaked artefacts in each layer.

Levels	Trench C 18		Trench B 6	
	Below 75 cm	Above 75 cm	Below 60 cm	Above 60 cm
Percentages of materials—				
Bryozoan chert	3%	0·1%	5·9%	0·3%
Silcrete	1·5%	nil	0·4%	nil
Mylonite	1·8%	8·5%	2·9%	9·4%
Percentages of secondarily worked/utilized items	8·9%	10·05%	8·1%	12·5%
Percentages of formal tools	2·4%	5·0%	3·6%	5·1%
Range of types of formal tools	4 types	7 types	3 types	6 types
Percentages of some formal tool types—				
Steep scraper	0·56%	0·28%	0·4%	0·3%
Fabricator	0·35%	1·1%	1·1%	0·6%
Adze, miscellaneous	nil	0·63%	nil	0·6%
Flat adze	nil	0·76%	nil	0·3%
Backed tool	nil	0·56%	nil	2·0%
Flake dimensions (except chips)—				
Mean width	17 mm	15 mm	Insufficient data	
Mean thickness	6 mm	5 mm	Insufficient data	
Total flaked artefacts	1 441	1 433	272	351

and Merrilees 1973); and more numerous occurrences later (Wright 1970, p. 90). Fabricator dimensions are listed in Table 2, where length is taken as the maximum distance between bipolar altered edges, and width as the maximum measurement normal to length.

One item from spit 4, a slab of quartz 7.6 cm long, trimmed bifacially at one end to a sharp sinuous edge is perhaps a chopping tool or Kodja. No edge-ground items were excavated although a few occurred in surface collections (Butler 1958, Ride 1958, Akerman 1969). Four large broken pebbles (one used as an anvil) were found near the bottom of the trench. One small oval pebble with use marks at each end was probably a hammer-stone. Six pieces from various levels had one face uneven but partly smoothed, evidently rubbed on some other object. Four of these were small slabs of granite 6 to 10 cm long and about 2 cm thick.

Flat adzes

This tool type occurred in levels above 75 cm in the trench at Walyunga. Akerman (1969, p. 15) illustrated examples from a surface collection at Walyunga and described them as concave or biconcave adzes or slugs.

"Flat adze" is the term suggested by Gould and Quilter (1972) for a type of small implement collected by Gould at two sites about 450 km northeast of Perth, and from surface collections from South Bullsbrook and Walyunga, held at the Western Australian Museum. Three qualitative attributes apply to flat adzes: (1) "Steep unifacial retouch along the working edge (or edges)"; (2) "Small, terminated flakes appearing along the bulbar face of the adze flake, directly behind the working edge", (Gould and Quilter 1972, p. 3); (3) "Successive use and resharpenings, however, caused the working edges of these tools to become deeply concave" (p.5). The tools were "extremely small" (p. 11). Mean thickness was 5.4 mm, and mean edge angle 46.5°. The items in Gould and Quilter's scale drawings have maximum dimensions averaging 27 mm. Their term "width" is ambiguous.

A set of 51 flat adzes from surface collections at Walyunga by Butler (1958) and others, now held at the Western Australian Museum, had mean dimensions similar to Gould and Quilter's except edge angle (65° in the Walyunga set). Mean length was 26 mm, mean width 12.8 mm and mean thickness 5.6 mm. The excavated specimens are smaller (Table 2), perhaps due to a more systematic recovery process. These items were worked on one or sometimes both lateral margins (Fig. 3). Some of the original bulb of percussion usually remained, showing that it was small, while the bulb:platform angle was less than 110°. The last two attributes are similar to those of backed tools from this district and quite unlike those of small or large tula adzes. In measuring these tools length was taken as the greatest dimension of the tool. This was in most cases in the direction of the blow of percussion that produced the flake, and parallel to the worked edge(s). Width was the maximum measurement at right angles to length in the plane of the bulbar face. Thickness was the maximum measurement normal to the bulbar face.

The age of flat adzes was previously unknown. In the Walyunga sequence they appeared first between 4 560 and 3 220 bp, then persisted throughout upper levels with backed tools. The flat adze thus belongs within Mulvaney's "Inventive Phase" as suggested by Gould and Quilter (1972, p. 11).

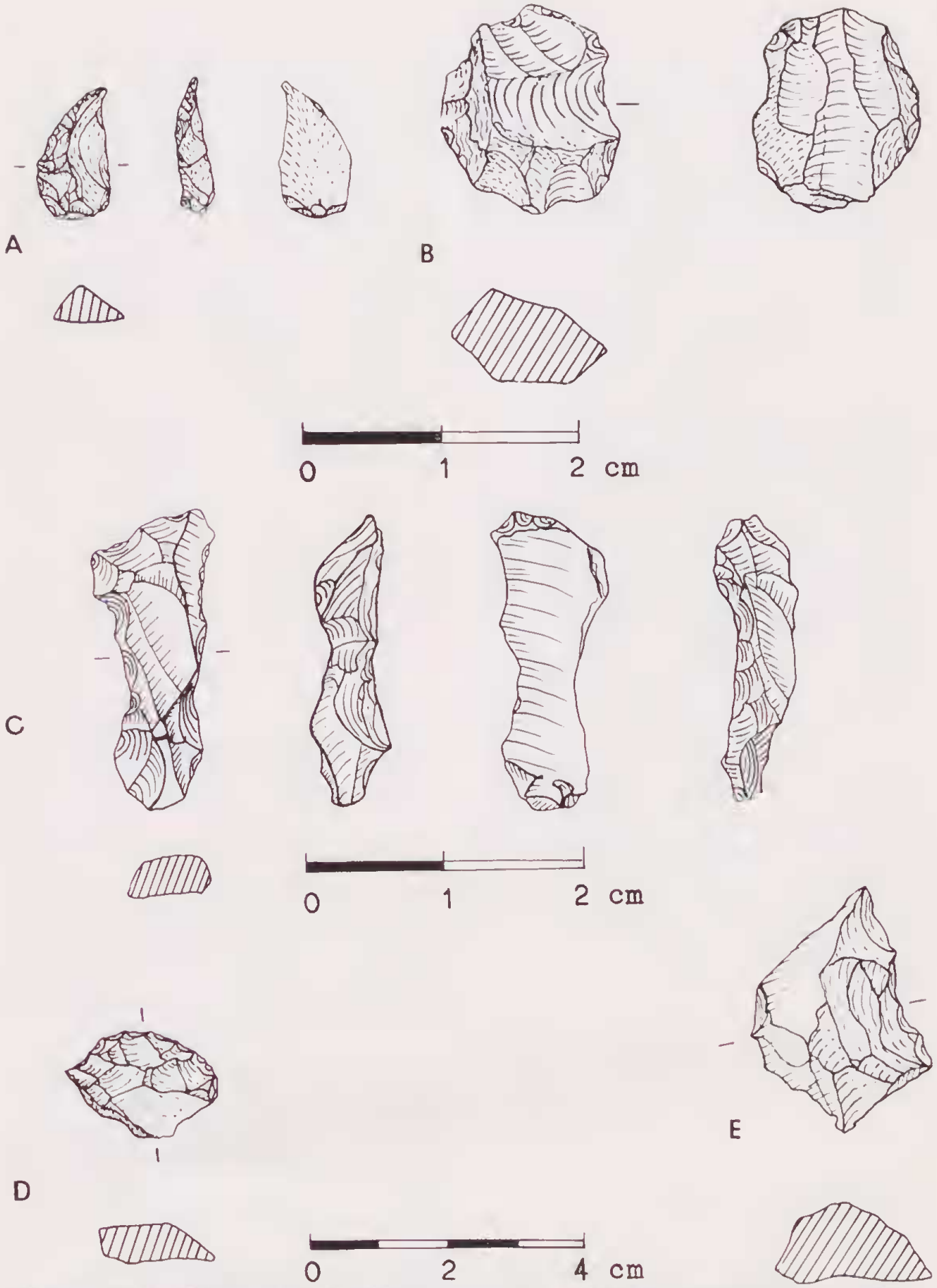

Figure 3. — Five tools from Walyunga excavation, trench C18. A. — Backed tool, quartz, depth 33 cm, Cat. No. P6/23. B. — Microscraper, quartz, depth 34 cm, Cat. No. P7/9. C. — Flat adze, mylonite, depth 39 cm, Cat. No. P9/1. D. — Knife, quartz, depth 148 cm, Cat. No. P31/23. E. — Scraper, quartz, depth 154 cm, Cat. No. P32/7.

Backed tools

Backed tools occurred only in the upper levels of the Walyunga excavation; the earliest in spit 14, depth 60 to 65 cm, dated 3 220 ± 100 bp (SUA 508), and the latest in spit 3, 16 cm below surface and 4 cm above the level dated 1 330 ± 100 bp (SUA 632). This latest backed tool may be anything up to about 1 300 years old, since the material in spit 3 is probably the residue from disturbance and erosion affecting part of the deposit that accumulated after 1 300 bp.

The interval between spits 14 and 19 (3 220 to 6 135 bp) contained only 275 artefacts including chips. The absence of backed tools from such a small sample is not conclusive proof that they were absent throughout the site in that interval.

The time range of backed tools found at Walyunga is slightly earlier than the range 3 090 bp to "modern" at Frieze Cave, located 80 km to the east (Hallam 1972, p. 16). Backed tools dated earlier than these are reported by Dortch (1975) from excavation at a site near Northcliffe 300 km south of Perth. Charcoal 3 to 7 cm above the uppermost backed tool at Northcliffe was dated 3 080 ± 75 bp (ANU 1131), while the sample from a spit 10 cm thick and 1 to 3 cm below the lowest backed tool was dated 6 780 ± 120 bp (SUA 379). This industry could be considerably older than the backed tool component at Walyunga.

Most of the backed tools excavated at Walyunga seem to be made from flakes rather than blades. They are trimmed in a curve along all or part of one lateral margin, usually to a squat asymmetric shape (Fig. 3). All from the trench sample were made of quartz except one of mylonite, and most are very small (mean dimensions listed in Table 2). These figures agree with the samples from systematic surface collection, but not with those from early casual collections which contain 30% mylonite items and are much larger (mean length 23 mm).

Backed tools in the Walyunga excavations occurred over about the same time span as flat adzes. Both types were components of the tool kit in the upper levels, and neither occurred before 4 560 bp.

Flakes

Most of the 260 primary flakes were less than 3 cm long, and their mean length (measured in the direction of percussion) was 1.8 cm (excluding chips less than 1.5 cm long). For comparison the mean length of secondarily worked flakes was 1.9 cm, while for 35 mylonite flakes and tools it was 1.7 cm. However some of the mean values changed over time (Fig. 4). Mass, width and thickness of primary flakes decreased in mean values from bottom to top levels of the trench, while length and length:width ratio showed a temporary increase around 3 000 bp (depth 90 to 45 cm), possibly related to changes in stone-working techniques or the introduction of new tool types.

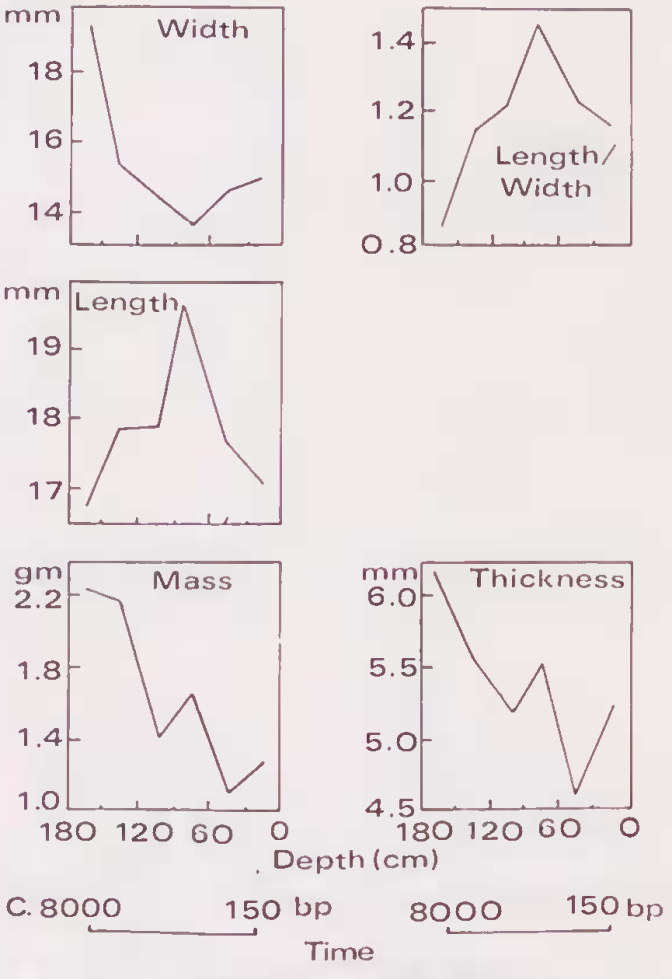

Figure 4. — Variations in flake sizes with time (N = 232). The graphs show variations with time in mean values of main dimensions of unaltered flakes from Walyunga trench C18. Flakes were grouped from successive 30 cm depth intervals. Items of dolerite, and chips less than 15 mm long were excluded.

About 24 "long" flakes have length:width ratios over 2.0, but only 6 are blades with parallel straight lateral margins and arrisses. These 6 items, less than 3 cm long and 1 cm wide, from lower as well as upper levels, may have been produced from scalar cores, as no prismatic or pyramidal cores occur. Some flaked pieces are probably cores though not of standard shapes, and occasionally they show narrow flake scars.

Rate of accumulation

The overall result of sand movement near the dune crest was aggradation, but the rate of accumulation indicated by depths of dated levels was not uniform. The rate was slower between spits 19 to 14 (about 10 cm per 1 000 years) than below (about 30 cm per 1 000 years) or above (about 20 cm per 1 000 years). The differences must be due to variations in rates of deposition and/or erosion.

Intermittent erosion is possibly indicated by concentrations of artefacts in two narrow "bands" within spits 18 and 16, but quantities

are small (14 artefacts near 81 cm, and 15 artefacts near 73 cm below surface), they were not accompanied by soil unconformities, and thus do not indicate prolonged or severe erosion.

The alternative to increased erosion is a reduced rate of addition of sand onto the dune crest, which may be related to reduced human activity (fewer fires, less disturbance of the surface, more vegetation, less bare sand and lower sand mobility).

The degree of activity and occupation at the trench location in different periods may be indicated approximately by relative artefact frequencies (quantities per square metre per 1 000 years). The frequencies were about 470 per 1 000 years in the lower levels (spits 32 to 20), about 90 per 1 000 years in spits 19 to 14, and 400 per 1 000 years in upper levels. This indicates discontinuous or reduced occupation during the period around 6 000 to 3 000 bp. (Fig. 5).

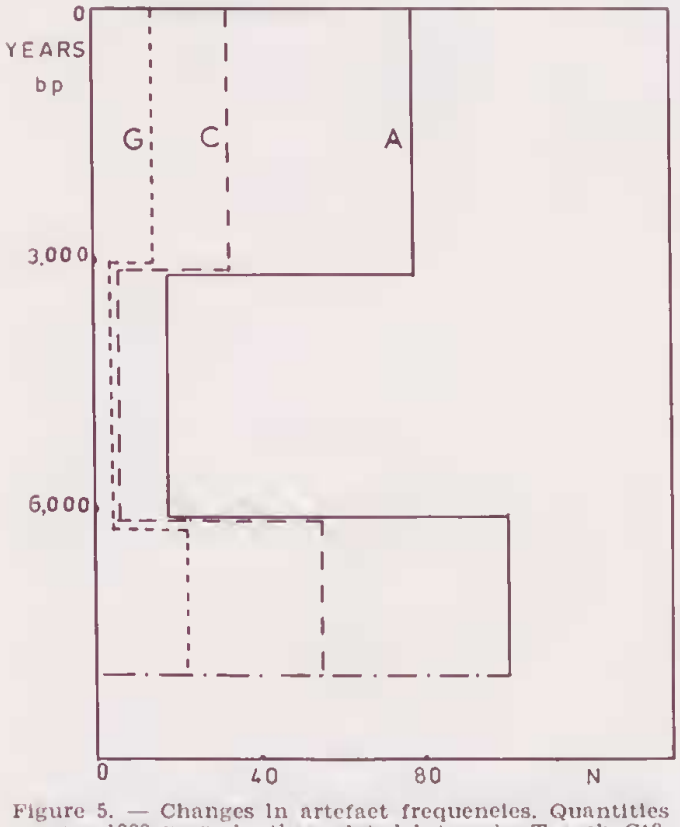

Figure 5. — Changes in artefact frequencies. Quantities per 1000 years in three dated intervals. Trench C18. A. — All flaked items except chips (N). C. — Chips, length less than 15 mm (N ÷ 10). G. — Lateritic gravel (grams).

Charcoal fragments occurred in most spits, occasionally concentrated in small areas but usually spread through the sand, probably windblown from fireplaces or bushfires in areas nearby. Charcoal was scarce in spits 16, 17 and 18, (depth 70 to 85 cm) compared with spits above and below, again indicating diminished occupation in this interval.

The evidence of dates in relation to stratigraphy, artefact density and charcoal density indicates a probable reduction of human activity in the immediate area of the trench from about 6 000 to 3 000 bp. This reduction may apply more widely over the site or represent only a shift in focus of usage. Nevertheless it does coincide with the period of marked changes in artefact technology.

Pollen studies by Churchill (1968) indicated a mid-Holocene dry climate for this region. Also Kendrick (1977) deduced from the presence of marine shells, a reduction in the flow of fresh water in the Swan and Helena Rivers and a relatively dry climate in the mid-Holocene. Thus some of the changes in human usage of the Walyunga site may be related to climatic changes.

Summary

Changes in technology (Table 3) appear as modifications in a continuing tradition rather than a succession of different traditions. The main changes are the disappearance of bryozoan chert and silcrete, a fivefold increase in mylonite usage, a decrease in frequency of steep scrapers, the introduction of backed tools and flat adzes, and a late increase in fabricators.

This dated sequence supports Glover's (1975) hypothesis that the source of bryozoan chert remained available until covered by rising sea levels. Various changes which took place about 4 600 years ago at Walyunga conform with similar changes which occurred in other parts of Australia after about 6 000 bp. "Backed" tools and "flat adzes" were absent from the lower levels and were present through the upper levels from at least 3 200 years ago.

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